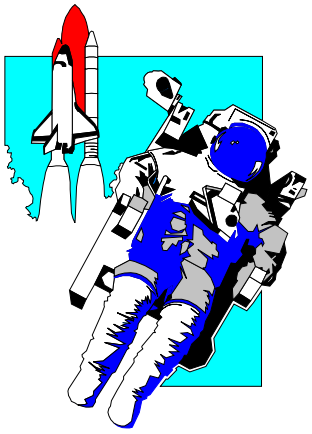
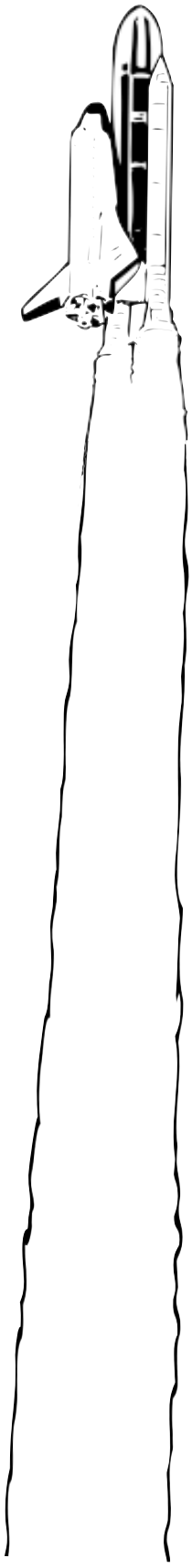


# Student Mathematics Activity: Carry That Weight

# Student Mathematics Activity: Carry That Weight



**Student Background**

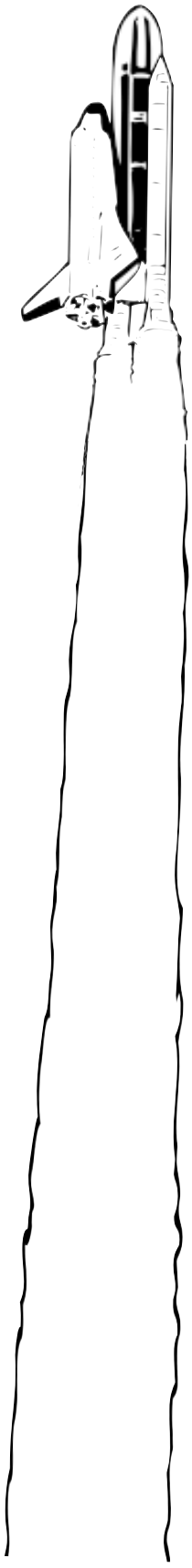
The orbiter must travel through more than 60 miles of the Earth's atmosphere to reach space. The total weight of the orbiter, its crew, payload, fuel tanks, rocket fuel and other miscellaneous items must not be greater than the amount of thrust it would take to propel it to an orbit just outside of the thermosphere.

Using mathematical calculations, rocket researchers have been able to determine just how much thrust is needed to launch a certain amount of weight. With a fully loaded orbiter and fuel tanks, it takes over 5 million pounds of thrust to launch the orbiter into space. To determine this amount of thrust NASA must consider the weight of every item being taken on each mission. The approximate weight of each item is listed in the chart below.

**Space Shuttle Mission Weight Chart**

| Item Description | Weight (in kilograms) |
|---|---|
| Orbiter (empty) | 43,092 |
| Payload (standard maximum weight) | 24,948 |
| External Tank (full) | 750,980 |
| Solid Rocket Booster (each) | 589,670 |
| (x 2 = ) | 1,179,340 |
| Other:<br>• Crew members (3-10)<br>• Additional fuel for use during mission<br>• Liquids & gases for electrical production & environmental conditioning | 14,850 |

# Student Mathematics Activity: Carry That Weight (continued)



**Directions:** As Director of the next space shuttle mission to be commanded by Eileen Collins, you will be in charge of making sure the orbiter's maximum weight does not exceed 102,600 kg. Follow the steps below and complete the chart on the next page.

1. Choose 4 of your classmates to join you and Commander Collins on the next mission. Record each classmate's name and each classmate's weight in kilograms.

**Crew Members Weight**

| Crew Member | | Weight In Kilograms |
|---|---|---|
| Commander Collins | = | 60 |
| My Name: _____ | = | |
| Classmate:_____ | = | |
| Classmate:_____ | = | |
| Classmate:_____ | = | |
| Classmate:_____ | = | |
| Total Crew Weight | = | |

2. Choose what will be brought on this mission from the payloads listed below by checking each item you will bring. Then total their combined weight. Make sure you do not exceed (go over) the total mission weight. Record the total payload weight here: _____.

Space Habipod = 18,000 kg

Curie Deep Space Observatory = 21,150 kg

Weather Satellite = 17,100 kg

Amateur Radio Station Experiment = 1,800 kg

Spectrometer Tests = 1,125 kg

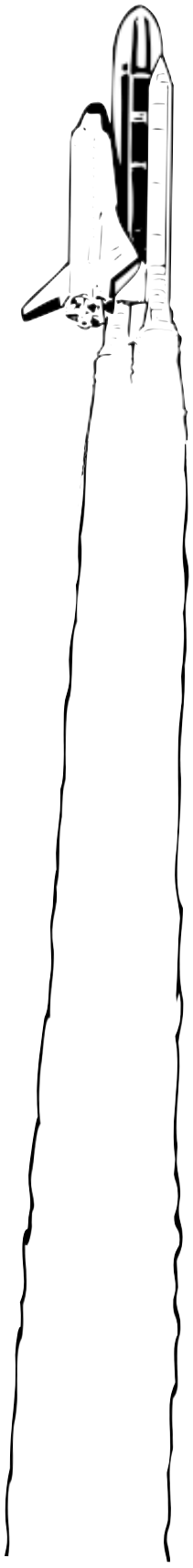
Microgravity Lab Experiment Kit = 2,700 kg

Atmospheric Lab = 4,590 kg

U-V Telescope Experiment = 3,555 kg

Global Positioning Systems Check = 900 kg

# Student Mathematics Activity: Carry That Weight (continued)

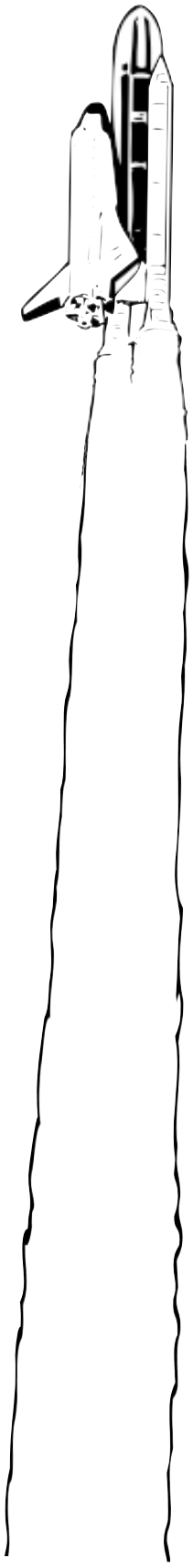


3. Complete the chart on this page by using information from the Space Shuttle Mission Weight Chart and the Crew Members Weight from the previous pages.

## Your Mission Weight Chart

| Item Description | Weight (in kilograms) |
|---|---|
| Orbiter (empty) | |
| Payload | |
| External Tank (full) | |
| Solid Rocket Booster (each) | 589,670 |
| x 2 = | |
| Other: | |
| • Crew members (6) | |
| • Additional fuel for use during mission<br>• Liquid & gases for electrical production & environmental conditioning (together) | ~14,490 |
| **Total Mission Weight**<br>(not to exceed 2,013,210) | |

# Student Mathematics Activity: Carry That Weight - Key

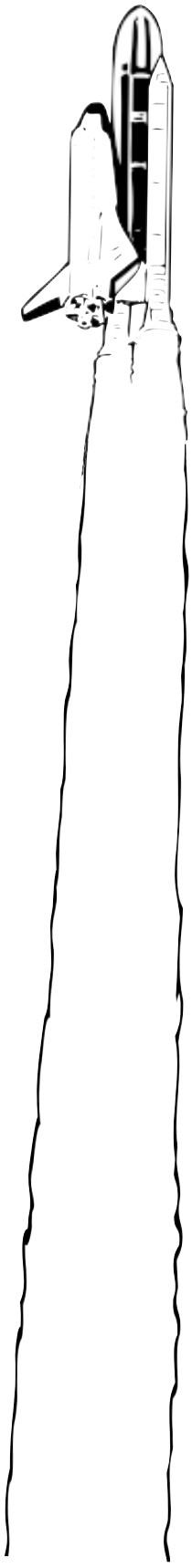


3. Complete the chart on this page by using information from the Space Shuttle Mission Weight Chart and the Crew Members Weight from the previous pages.

## Your Mission Weight Chart

| Item Description | Weight (in kilograms) |
|---|---|
| Orbiter (empty) | 43,092 |
| Payload | ~ 24,948 |
| External Tank (full) | 750,980 |
| Solid Rocket Booster (each) | 589,670 |
| x 2 = | 1,179,340 |
| Other: | |
| • Crew members (6) | ~ 360 |
| • Additional fuel for use during mission<br>• Liquid & gases for electrical production & environmental conditioning (together) | ~ 14,490 |
| **Total Mission Weight**<br>(not to exceed 2,013,210) | *answers will vary* |

# Student Mathematics Activity: Carry That Weight
## Let's Convert

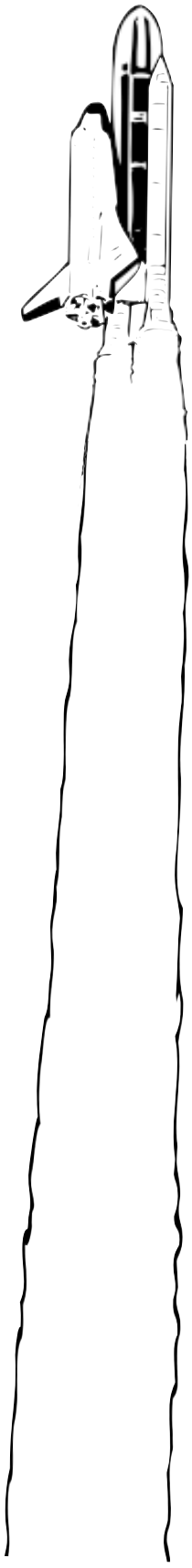


**Directions**: Use the given measurements to convert the weights into kilograms, pounds and tons. In the final column, name an object (or a number of them) that would weigh the same amount.

### Mission Weight Chart Conversion

| **Item Description** | **Weight** | | | |
|---|---|---|---|---|
| | kilograms | pounds | tons | familiar object |
| Orbiter (empty) | 43,092 | | | |
| Payload (standard maximum weight) | | | 27.44 | |
| External Tank (full) | | 1,652,156 | | |
| Solid Rocket Booster (each) | 589,670 | | | |
| (x 2 =) | | | | |
| Other:<br>• Crew members<br>• Additional fuel for use during mission<br>• Liquids & gases for electrical production & environmental conditioning | | 33,000 | | |
| **Total Lift-Off Weight** | | | 2214.5 | |

# Student Mathematics Activity: Carry That Weight
# Let's Convert - Key

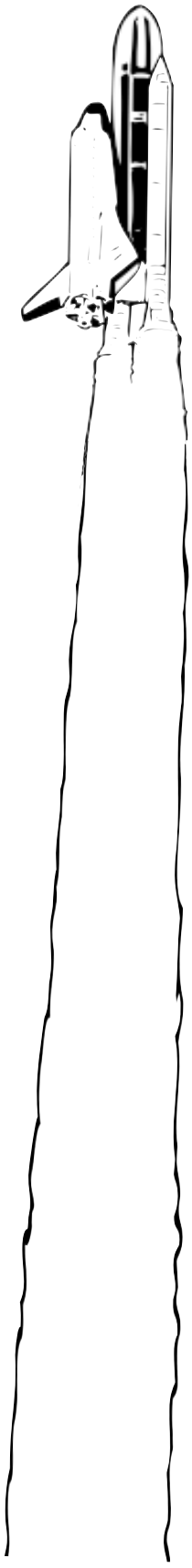


**Directions**: Use the given measurements to convert the weights into kilograms, pounds and tons. In the final column, name an object (or a number of them) that would weigh the same amount. *Depending upon the conversion method used, answers will vary. Two answers for tons are given for ease in checking answers.*

## Mission Weight Chart Conversion

| **Item Description** | **Weight** | | | |
|---|---|---|---|---|
| | kilograms | pounds | tons | familiar object |
| Orbiter (empty) | 43,092 | 94,802.4 | 47.5<br>47.4 | 1 big rig truck |
| Payload (standard maximum weight) | 24,948 | 54,885.6 | 27.44 | 5 elephants |
| External Tank (full) | 750,980 | 1,652,156 | 827.98<br>826.08 | 16 big rig trucks |
| Solid Rocket Booster (each) | 589,670 | 1,297,274 | 650.13<br>648.64 | 13 big rig trucks |
| (x 2 =) | 1,179,340 | 2,594,548 | 1,300.26<br>1,297.27 | 26 big rig trucks |
| Other:<br>• Crew members<br>• Additional fuel for use during mission<br>• Liquids & gases for electrical production & environmental conditioning | 14,850 | 33,000 | 16.37<br>16.5 | 3 elephants |
| **Total Lift-Off Weight** | 2,013,210 | 4,429,062 | 2,219.6<br>2,214.5 | 44 big rig trucks |

# Student Mathematics Activity: Carry That Weight
# Teacher Conversion Hints



To convert from kilograms to pounds

(kg to lbs.) **kg x 2.2 = lbs.**

To convert from pounds to kilograms

(lbs. to kg) **lbs. x .45 = kg**

To convert from pounds to tons

(lbs. to tons) **lbs. / 2,000 = tons**

To convert from tons to pounds

(tons to lbs.) **tons x 2,000 = lbs.**

To convert from kilograms to tons

(kg to tons) **kg / 907 (907.2) = tons**